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NASA CONTRACTOR REPORT 166600

DOUBLE LAYERED TAILORABLE ADVANCED BLANKET INSULATION

(NASA-CR-166600) DOUBLE LAYERED TAILORABLE
ADVANCED BLANKET INSULATION (Thompson (H.
I.) Fiber Glass Co.) 31 p HC A03/MF A01

N84-33591

CSCL 11E

Unclas
22521

G3/27

DAVID FALSTRUP



CONTRACT NAS2-11351
MAY 1983

NASA

NASA CONTRACTOR REPORT 166600

DOUBLE LAYERED TAILORABLE ADVANCED BLANKET INSULATION

DAVID FALSTRUP
WOVEN STRUCTURES
DIVISION OF HITCO
618 WEST CAROB STREET
COMPTON, CALIFORNIA 90220

PREPARED FOR
AMES RESEARCH CENTER
UNDER CONTRACT NAS2-11351



National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035

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1.0 BACKGROUND

Previous space shuttle flights used flexible insulation blankets consisting of insulating material sandwiched between two layers of woven fabric. These layers were then stitched together with rows of stitching in two perpendicular directions. Future space shuttle flights might benefit from alternative advanced flexible insulation blanket with integrally woven layers, eliminating the stitching, and with different insulating materials in different layers.

1.0 OBJECTIVES

The program plan was for Woven Structures, a division of HITCO, subsidiary of ARMCO, Inc. to weave 366 cm (4 yards) of double layer triangular cell Hitcore® panels using quartz yarn (see Figure 1). The fabric width was to be 66.04 cm (26 inches) and the height was to be 2.54 cm (1 inch) overall. The node points between layers were to be staggered to provide the longest heat path between the top and bottom face (see Figure 2). One layer of cells was to be filled with Q-felt® insulation and the other with rigid insulating material supplied by NASA Ames and identified as FRCI8. The completed panel was to be supplied in minimum lengths of 106.7 cm (42 inches). All panel was to be heat cleaned at 454°C (850°F) for a minimum of 4 hours.

3.0 MATERIALS

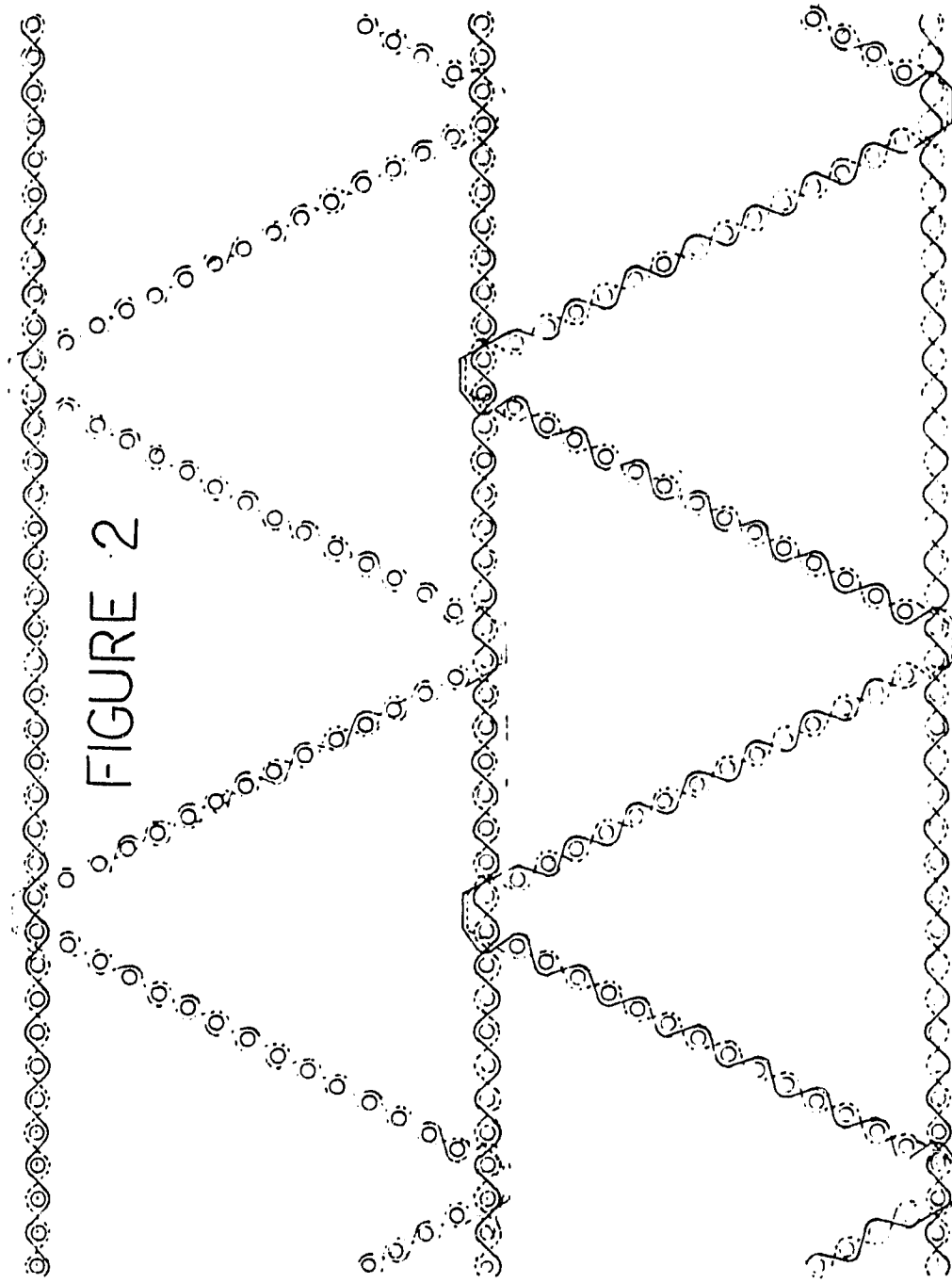
The quartz yarn selected for weaving was Alphaquartz® type 300-2/4-Q57 having a starch-oil binder and was obtained on special order from A.A.I. Products, Inc.

The Q-felt purchased from Johns-Manville Corp. was six pounds per cubic foot density material obtained in standard sheets, ½" x 36" x 60".

The acrylic solution used for rigidifying the Q-felt was prepared to Woven Structures Process Specification PS-0106 using Carboset® 514-H resin from B. F. Goodrich (see Appendix).

| | |
|--------------|---|
| HITCORE® | Trademark of HITCO |
| Q-FELT® | Trademark of Johns-Manville Corporation |
| ALPHAQUARTZ® | Trademark of A.A.I. Products, Inc. |
| CARBOSET® | Trademark of B. F. Goodrich |

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SCHEMATIC OF DOUBLE LAYER HITCORE WEAVE

4.0 PROCEDURE (See Figure 3)

4.1 Weaving

4.1.1 Loom Set Up

A 122 cm (48 inch) C & K fly-shuttle loom was chosen to weave the panel due to the following features.

- a) The take-up roll has metal spikes over its entire surface, suitable for pulling thick fabrics.
- b) A set of pinch rolls controls the rate of let-off of part of the warp, and is programmable from the head motion.
- c) 3 x 1 box motion allows the use of 3 separate fill yarn systems.
- d) The head motion allows control of sufficient number of harnesses, as well as let-off and take-up motion.
- e) The motor is 1.49 kW (2 horsepower) and has sufficient power to lift the more than average number of warp ends.

The following further modifications were made to allow weaving of the panel;

- a) Spring tension bars were set-up at the back of the loom to maintain warp shed during weaving.
- b) A double ratchet take-up system was installed to allow accurate placement of fill yarns and to allow the warp to be let-back a controlled distance at certain stages in the weaving sequence.

4.1.2 Debugging

The loom was set-up and debugging achieved using glass fill yarn and an existing surplus warp creel set-up containing 960 ends of quartz yarn. This allowed weaving a 20.3 cm (8 inch) wide test sample, and conserved loss of expensive quartz yarn during debugging.

PROGRAM FLOW CHART

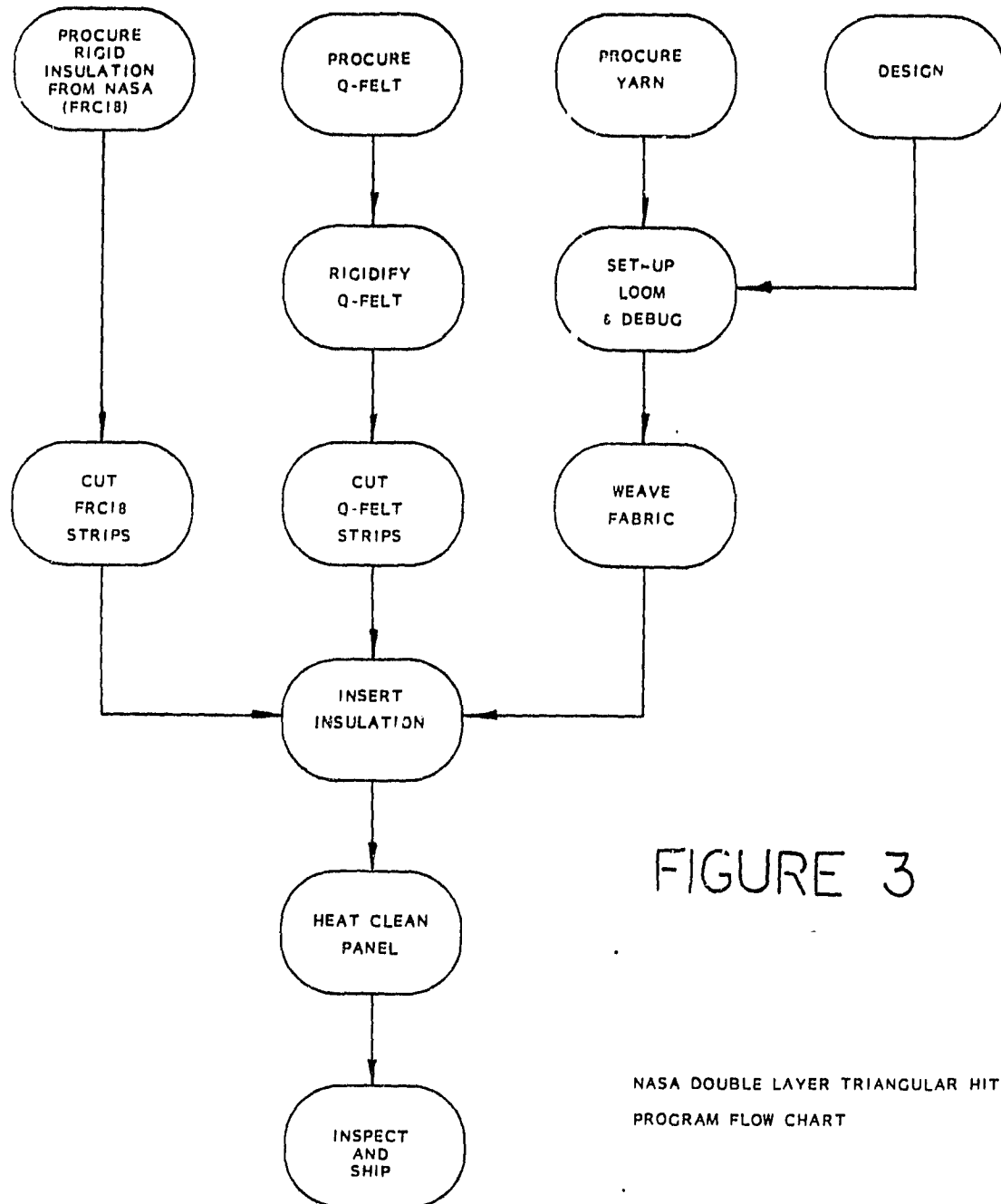


FIGURE 3

NASA DOUBLE LAYER TRIANGULAR HITCORE
PROGRAM FLOW CHART

ISLWOF 5/8/3

4.1.2 Debugging (Cont'd.)

When weaving of the narrow sample began, the fly shuttle had a tendency to escape from the race plate of the loom which was attributed to the narrow width of warp.

An incomplete warp let-back occurred due to the low number of ends and corresponding low total creel tension. For debugging purposes, this was alleviated by adding additional weights to each warp end supplying the faces of the panel.

A set of mahogany inspection mandrels was obtained to check the cell sizes and the sample was checked and found to be satisfactory in size and weave pattern.

4.1.3 Weaving

A creel set-up of 3200 ends of Alphaquartz yarn was drawn-in to allow 68.6 cm (27 inches) of fabric at the reed. This was anticipated to give 66.04 cm (26 inches) width when removed from the loom. Weaving was initiated using quartz fill.

Due to the low shear strength of the quartz yarn, the fill broke each time the shuttle entered the box. This situation was aggravated by having a yarn with unbalanced twist. The problem was overcome by careful box binder adjustments and by raising the box front and making a fur-lined slot in the box front leather to hold the fill yarn while inside the box.

Many warp end spools contained fuzzy yarn, which resulted from abrasion in the winding process. These ends would break repeatedly during weaving and were later replaced by non-fuzzy yarn.

4.1.4 Mechanical Problems

During weaving, the following mechanical problems occurred, causing delays to the program.

4.1.4 Mechanical Problems (Cont'd.)

- a) Different jacks in the head would break off under the extreme load, and had to be replaced. Also, the box motion lever fractured from fatigue and was repaired.
- b) The head failed to lift some of the harnesses which were programmed on the pattern chain. This caused the cells to be locked together and warp ends to break. After adjustments in the head motion, this problem was overcome.
- c) The take-up ratchet push arms, or holding pawls would slip from the ratchet teeth causing cell size variations. This was due to cable hang-up and misaligned teeth and/or pawls, and was overcome by modifying the cable path and by careful ratchet adjustments.

4.2 Insulation Insertion

- 4.2.1 Two types of insulation were to be inserted into the panel. The rigid insulation supplied by NASA Ames could simply be cut to shape with a clean table saw and inserted. The Q-felt insulation was supplied as a soft felt-like sheet and could not be inserted as received.

The procedure for inserting Q-felt into the cells of Hitcore involved rigidifying with the Carboset acrylic solution which was later burned off.

4.2.2 Rigidification

A buffered acrylic latex solution was prepared to Woven Structures Process Specification PS-0106, and further diluted with deionized water in a one-to-one ratio (see Appendix). Previous tests indicated that this solution would not leave any significant contamination on the fabric if heat cleaned at 454°C (850°F) for 4 hours.

The sheets of Q-felt were cut into 30.48cm x 66.04 (12" x 26") long pieces, saturated with 1000 cm³ of the acrylic latex solution and then pressed between flat, Mylar-covered plates to 1.14 cm (0.45 inches) height. The slabs were then placed

4.2.2 Rigidification (Cont'd.)

on Mylar-covered galvanized steel sheets and dried in an oven at 121°C (250°F) for eight hours. They were then removed from the oven and allowed to cool and set.

4.2.3 Cutting

The rigidified slabs were cut into strips 66.04cm (26 inches) long using a table saw with a chrome plated blade. Each strip had a truncated isosceles triangle cross-section having essentially the same dimensions as the cells of the woven panel (see Figure 4). The strips were inserted by hand into one layer of the panel. Extreme care had to be exercised so as not to tear the fabric while inserting the strips.

The blocks of rigid insulation were supplied by NASA Ames in various sizes which could be cut into strips 33.02cm (13 inches), 16.51 cm (6½ inches) or 13.34cm (5¼ inches) long and with the same cross-section as the Q-felt strips. These strips were inserted into the second layer of cells in the panels. In the first two panels woven, two pieces were used per cell, each 33.02cm (13 inches) long. In the third panel, four pieces were used per cell, each 16.51cm (6½ inches) long. In the fourth panel, five pieces were used per cell, each 13.3cm (5¼ inches) long. The strips were very brittle and had a tendency to break during insertion.

4.2.4 Heat Cleaning

The three panels, including insulation, were heat cleaned at 454°C (850°F) for four hours to burn off the acrylic solution and any organic contaminants (see Figure 5). The panels showed some residual discoloration, and were heat cleaned for a second time at 454°C (850°F) for four hours, removing all discoloration.

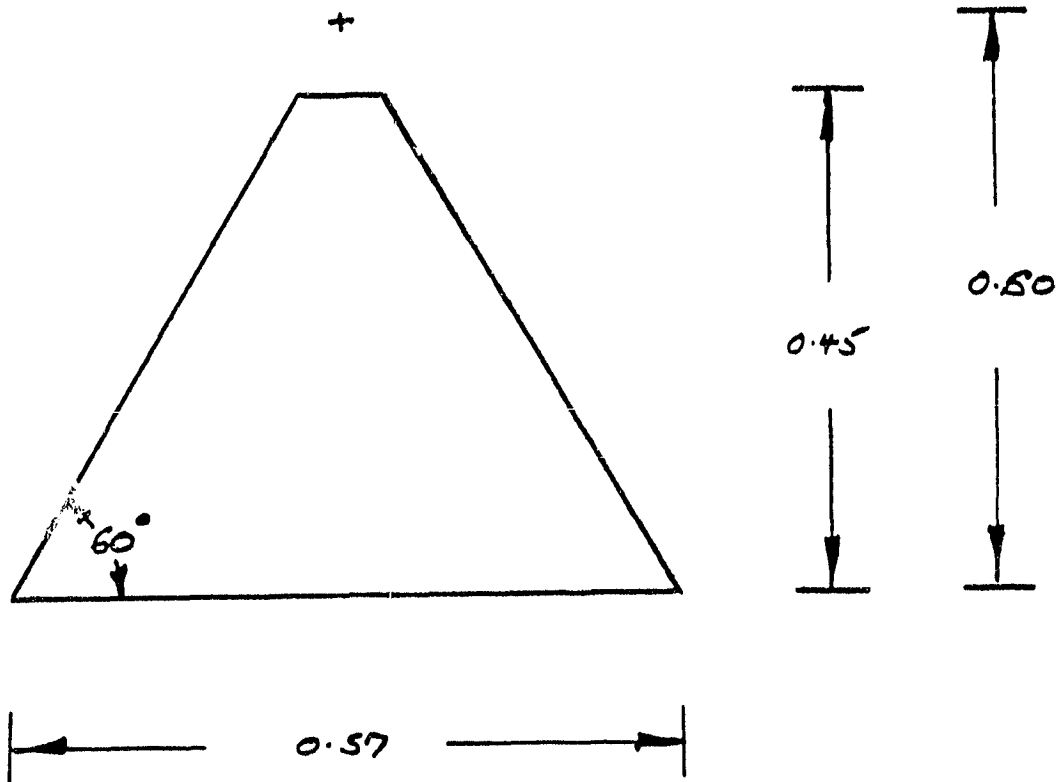
5.0 RESULTS

A total of approximately 914cm (thirty feet) of panel was woven. From this fabric four acceptable pieces were obtained; two approximately 366cm (four feet) long, one approximately 71.1cm (28 inches) long, and one approximately 76.2cm (30 inches) long. These later had insulation inserted. Each

| REVISIONS | | | | |
|-----------|-----|-------------|------|----------|
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | | | | |

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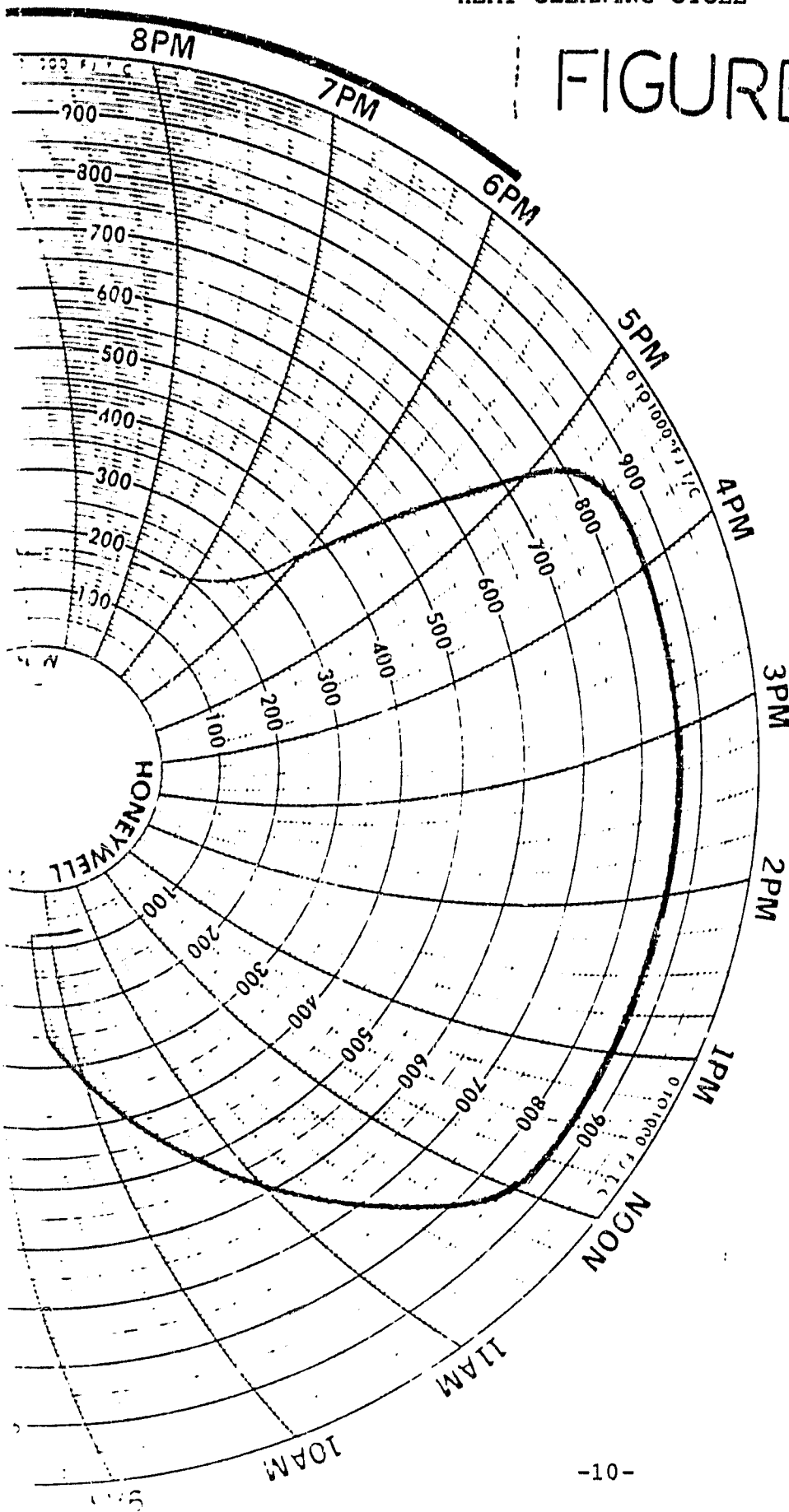
FIGURE 4



| | | | | | |
|--------------------------------------|--|------------------|------------------|---|---------|
| DRAFTSMAN <i>David F. B. King</i> | | DATE | | WOVEN STRUCTURES DIV. OF HITCO COMPTON, CALIFORNIA | |
| CHECKER <i>4/83</i> | | DATE | | | |
| APPROVED | | DATE | | END VIEW OF INSULATION STRIPS. | |
| ES 1715 | | A | FSCM NO 33739 | DWG NO 750 | REV |
| 391042 | | SCALE <i>NRS</i> | | INCHES | SHEET 3 |

HEAT CLEANING CYCLE

FIGURE 5



5.0 RESULTS (Cont'd.)

completed panel had a useable width of 66.04cm (26 inches). A laboratory test showed the areal weight of greige goods to be 1645g.m.^{-2} (48.36 oz/yd^2) and the areal weight with insulation to be 4578g.m.^{-2} (135 oz/yd^2). The pick count in each face was 9.45 yarns per cm (24 per inch) and the warp count was 9.65 yarns per cm (24.5 per inch) (see Appendix).

6.0 CONCLUSIONS

WSI successfully wove double layer triangular Hitcore from quartz yarn, using a modified loom. In addition, WSI inserted two types of insulation into the cells of the fabric, using a rigidification process for one of the insulation materials. The processes used are considered well suited for further production.

APPENDIX

The following attachments are included:

- I Materials Shipped
- II WSI Test Report
- III WSI Process Specification
- IV Properties of Alphaquartz
- V A.A.I. Certification
- VI Manville Certifications
- VII Carboset Resin Bulletin

APPENDIX - I

MATERIALS SHIPPED

DOUBLE LAYER TRIANGULAR HITCORE, WITH INSULATION

| <u>NO.</u> | <u>LENGTH (INCHES)</u> | <u>WIDTH (INCHES)</u> | <u>HEIGHT (INCHES)</u> | <u>WEIGHT (LB.)</u> | <u>NUMBER OF PIECES OF RIGID INSULATION PER CELL</u> |
|------------|----------------------------|---------------------------|----------------------------|-------------------------|--|
| 1 | 38 3/4 | 26 1/2 | 1 | 6.5 | 5 (@ 5.2") |
| 2 | 28 3/4 | 26 1/4 | 1 | 5.2 | 4 (@ 6.5") |
| 3 | 46 3/4 | 26 1/4 | 1 | 7.7 | 2 (@ 13") |
| 4 | <u>48 3/4</u> | 26 1/2 | 1 | <u>8.5</u> | 2 (@ 13") |
| | 163 | | | 27.9 | |

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APPENDIX - II
HITCO TECHNICAL SERVICES
TEST REPORT

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DATE: 4/21/83
FOR: NASA Ames
ATTN: Paul Sawko
CC: _____

NUMBER OF SAMPLES: 2 TEST NO: WS-83-4-15
TYPE OF MATERIALS: _____
Alphaquartz 300 2/4, 3.8S
ES-1693, Double Layer Triangular Hitcore

QUALIFICATION ☐

ACCEPTANCE ☐


P.O. OR REQUEST ☐

METHODS: _____

| | ENDS PER INCH | PICKS PER INCH | | NET AREAL WEIGHT (g/m ²) | WEIGHT (Oz/Yd ²) |
|-----------------|------------------|-------------------|--------------|---|---------------------------------|
| | | | | | |
| | | | | | |
| GREIGE GOODS | 24.5 | 24 | (Each Layer) | | |
| | 122.5 | 153 | (5 Layers) | 1645 | 48.4* |
| | | | | | |
| | | | | | |
| With Insulation | | | | 4578 | 135 |
| | | | | | |
| | | | | | |
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| | | | | | |
| | | | | | |
| | | | | | |
| REQUIREMENTS: | | | | | |

COMMENTS: _____

*1% allowed for sizing removal.

| | | | |
|---|---|---------------------------------|-------------------------------|
|  <p>Woven Structures DIVISION OF MITCO</p> <p>PROCESS SPECIFICATION</p> | Title: PREPARATION OF ACRYLIC LATEX ES 1468 | | |
| | Original Issue Date April 3, 1978 | Number PS-0106 | Revision |
| | Latest Revision Date | | Prepared By <i>R. Puck</i> |
| | Approved By <i>W. Miller</i> | Approved By <i>W. Miller</i> | Page 1 of 2 |

1.0 PURPOSE AND SCOPE

This procedure is intended to cover the raw materials required, the formulation, and the process needed to produce acrylic latex ES 1468 in production quantities. The material is intended for use in rigidizing fabrics prior to cutting and trimming operations.

2.0 RAW MATERIALS

2.1 Acrylic resin, Carboset 514-H, B. F. Goodrich, 3055 Wilshire Blvd., L. A., Ca. 90010.

2.2 Aqueous ammonia, concentrated, reagent grade.

2.3 Deionized water.

3.0 EQUIPMENT

3.1 Carboy, polyethylene, Nalgene, 5 gal, V.W.R. Catalogue # 16338-039

3.2 Mixing motor

3.3 Stainless steel mixing impeller

3.4 Rubber gloves

3.5 Plastic face shield

4.0 FORMULATION

The following ingredients when mixed in this formulation will produce approximately five gallons of acrylic latex:

| | |
|-------------------------------|----------|
| Deionized water | 9 liters |
| Aqueous ammonia, concentrated | 225 ml |
| Carboset 514-H acrylic resin | 9 liters |

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5.0 MIXING PROCEDURE

- 5.1 Measure out 9 liters of deionized hot water at 125 - 150°F into a clean 5 gallon polyethylene carboy. Note - the use of hot water, although not imperative, will speed the dissolving step.
- 5.2 Add 225 ml of concentrated aqueous ammonia to the deionized water. Caution - rubber gloves and a plastic face shield must be worn when handling ammonia since severe chemical burns and irritation of the eyes or skin will result if spilled.
- 5.3 Slowly add the 9 liters of Carboset 514-H acrylic resin to the hot deionized water and ammonia solution while stirring with a stainless steel mixing impeller.
- 5.4 Continue stirring until all the resin is fully dissolved. Tightly cap the carboy to prevent evaporation.

6.0 DOCUMENTATION

- 6.1 An adhesive tag shall be attached to the side of the carboy having the following information:

ACRYLIC LATEX ES 1468

CARBOSET 514-H ACRYLIC RESIN

LOT NO. _____

PO NO. _____

MIX DATE _____

OPERATOR _____

INSPECTOR STAMP _____

- ~~6.2 The adhesive tag shall then be filled out with the appropriate information and the material released to manufacturing.~~

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Properties of ALPHAQUARTZ

Fiber Properties

| | |
|--|---------|
| Tensile Strength, P.S.I. @ 750°F, Dia. 8.0 microns | 126,000 |
| @ 1000°F, Dia. 7.5 microns | 133,000 |
| @ 1400°F, Dia. 7.4 microns | 99,200 |

Thermal Properties

| | |
|---|-----------------------|
| Avg Coeff. of Linear Expansion, 1°C (Temp. range 0-1852°C) | 0.54×10^{-6} |
| Specific Heat, Avg 0-500°C, cal/gm°C | 0.230 |
| Thermal Conductivity, K @ 20°C C.G.S., cal/sec.cm.cm ² .°C | 0.003 |
| Softening Point | 3032°F |
| Annealing Point | 2084°F |
| Strain Point | 1958°F |

Mechanical Properties

| | |
|-------------------------|------------------|
| Specific Gravity | 2.2 |
| Hardness Mohs scale | 5.6 |
| Poisson Coefficient | 0.17 |
| Young's Modulus, p.s.i. | 10×10^6 |

Typical Laminate Properties

| | |
|---------------------------|--------|
| Flexural Strength, p.s.i. | 77,000 |
| Tensile Strength, p.s.i. | 59,000 |

Electrical Properties

| | |
|-------------------------------------|-----------|
| Power Factor, 1 mc at 68°F | 0.0001 |
| Loss Factor, 1 mc at 68°F | 0.0002 |
| Dielectric Constant, 68°F | 3.7 |
| Volume Resistivity, ohm/cm at 390°F | 10^{13} |

Composition:

SiO₂ > 99.9%, Boron < 50ppm; Alkali Metals (Na, K, Li, calculated as Na equivalent)
< 50ppm; Al < 150ppm; Other impurities < 100ppm.

Above figures are for binder-free ALPHAQUARTZ. Coupling agents are normally applied during drawing to improve physical characteristics of laminates. Average pickup - < 5% by weight.



A.A.I. Products Inc. Two Amboy Avenue, Woodbridge, New Jersey 07095 (201) 634-5700 Telex #13-8024

A.A.I. PRODUCTS, INC.

A Subsidiary of ALPHA ASSOCIATES, INC.)

TWO AMBOY AVENUE, WOODBRIDGE, N.J. 07095 (201) 634-5700



TELEX
NUMBERS
138024
219938

CERTIFICATION

February 8, 1983

WOVEN STRUCTURES
P.O. #WS-5605
ORDER COMPLETE

PRODUCT: Alphaquartz Yarn
TYPE: Style 300-2/4-QS7
LOT NO.: 2-8/83
NUMBER OF
BOXES: 3
NUMBER OF SPOOLS: 30*
NET WEIGHT: 60 lbs.
SILICA CONTENT: 99.96%
BINDER COMPOSITION: 2.8%
Steramine CGL, 5.0% Sopralube ACR 265,
2.0% Solvitose N

*Yarn on one spool is damaged 1" above the base by Custom Inspectors.
We will therefore be billing you on the basis of 59.5 lbs.,
since we estimate probable loss in the neighborhood of .5 lbs.

This is to certify that the Alphaquartz Yarn 300-2/4-QS7 meets
the requirements of Woven Structure's Specification
#MS-0101, Revision A, dated September 28, 1977, for the
following paragraphs: Para. 2.7.2 and Para. 2.8.2.

A.A.I. PRODUCTS, INC.

Richard R. Safford, QC

A.A.I. PRODUCTS, INC.

A Subsidiary of ALPHA ASSOCIATES, INC.

TWO AMBOY AVENUE, WOODBRIDGE, N.J. 07095 (201) 634-5700



TELEX
NUMBERS
138024
219938

TEST REPORT

February 8, 1983

WOVEN STRUCTURES
P.O. #WS-5605
ORDER COMPLETE

Tensile Strength
lbs.

11.2 lbs.

Binder Content
%

0.64%

Moisture Content
%

< 0.05%

Yarn Yield
yd./lb.

3720 yds.

A.A.I. PRODUCTS, INC.

Richard R. Safir, QC

Manville Building Materials Corporation

PO Box 517

Manville, CO 80401

419 878 8111

Manville

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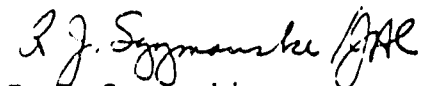
December 15, 1982

Woven Structures
HITCO
618 W. Carob St.
Compton, CA 90220

Gentlemen:

This is to certify that Manville Bldg. Materials Corp.'s standard inspection procedure has been used in the inspection of the material covered by this order. This inspection indicates that the material tested for Manville Bldg. Materials Corp. Order No. G92 ZK 01062, your Order No. WS 5606 complies with the applicable finished product requirements of Manville Bldg. Materials Corp.

Very truly yours,



R. J. Szymanski
Quality Control Manager

Certified in triplicate

Manville Building Materials Corporation
PO Box 517
Tulsa, Oklahoma 74103
409 878 8111

100-100000

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April 19, 1983

Woven Structures
Hitco
618 W. Carob St.
Compton, CA 90220

Gentlemen:

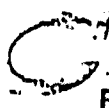
This is to certify that Manville Bldg. Materials Corp.'s standard inspection procedure has been used in the inspection of the material covered by this order. This inspection indicates that the material tested for Manville Bldg. Materials Corp. Order No. G92 ZK 00356, your Order No. WS5748 complies with the applicable finished product requirements of Manville Bldg. Materials Corp.

Very truly yours,



R. J. Gzymanski
Quality Control Manager

Certified in triplicate

ORIGINAL FILED
OF POOR QUALITY Carboset
RESINSCarboset 514H Resin
Bulletin GC-48Carboset[®] 514H Resin

Carboset 514H is a low molecular weight acrylic resin offered as a 40 per cent dispersion in ammonia water. Carboset 514H dries to a clear, water resistant, non-tacky, thermoplastic film and is compatible with other water soluble or water dispersible systems. The film adheres excellently to metal, leather, paper, treated polyethylene, and other materials. Suggested applications include adhesives, inks, latex paints, and temporary protective coatings.

Unlike our older product Carboset 514, (supplied at 30 per solids) which is nearly a clear solution, Carboset 514H is a colloidal dispersion, milky white in appearance. Carboset 514H behaves similarly to Carboset 514 at equal pH and solids. Carboset 514H, however, offers the compounder coating improvements because of higher total solids.

For more rapid drying, Carboset 514H can be diluted with a water-miscible solvent such as isopropanol, dimethyl formamide, or tetrahydrofuran. In the presence of moisture, the deposited film remains insoluble but extended immersion may cause blanching. The film can be completely removed with dilute alkaline solution.

Typical Properties
Carboset 514H Resin as Supplied

| | |
|------------------------------------|------------------------|
| Total solids, in ammonia water (%) | 40 |
| Viscosity @ 25°C (cps) | 3500 max. |
| pH | 6.7 - 7.3 |
| Appearance | milky white dispersion |

Films

| | |
|------------------------|---------------|
| Tensile strength (psi) | 1600 |
| Elongation (%) | 50 |
| Appearance | clear, glossy |

Solution Viscosities

The viscosity of Carboset 514H resin solutions is a function of the pH as well as resin concentration, as shown below.

| <u>Total Solids (%)</u> | <u>Viscosity (cps)</u> | | | |
|-------------------------|------------------------|---------------|---------------|---------------|
| | <u>pH 7.0</u> | <u>pH 7.5</u> | <u>pH 8.0</u> | <u>pH 9.0</u> |
| 20 | 9 | 12 | 14 | 16 |
| 25 | 11 | 20 | 50 | 250 |
| 30 | 18 | 200 | 10,200 | 80,000 |
| 35 | 40 | 45,000 | 250,000 | >1,000,000 |
| 40 | 500 | >1,000,000 | >1,000,000 | >1,000,000 |

The pH of the solutions detailed above was varied with ammonium hydroxide. Adjusting the pH with other weak neutralizing agents will result in similar viscosities. When the solution pH is adjusted with strong bases such as sodium hydroxide, the solution viscosities at equivalent pH are roughly half those above.

Drying Times

| <u>Film Thickness (Wet)</u> | <u>To Tack-Free Film</u> | | <u>To Water Resistance*</u> | |
|-----------------------------|--------------------------|--------------|-----------------------------|--------------|
| | <u>75°F</u> | <u>120°F</u> | <u>75°F</u> | <u>120°F</u> |
| 0.5 mil | 5 min. | 1 min. | 4 hrs. | 1 hr. |
| 2.0 mil | 5 min. | 2 min. | 6 hrs. | 3 hrs. |
| 3.0 mil | 10 min. | 10 min. | 16 hrs. | 16 hrs. |

*Resistance to 30 minutes exposure to water at room temperature without softening or blanching.

Film drying times are governed by film thickness, temperature and the initial pH of the system. In general, the thinner the film, the higher the temperature and the lower the pH (to a minimum of 7.0), the faster the films dry and become water resistant.

Carboset 514H Resin Film Solubility

Dilute aqueous alkaline solutions, readily remove Carboset 514H resin films. Examples of good film strippers are 5 per cent solutions of trisodium phosphate, sodium metasilicate, sodium carbonate, and ammonium hydroxide. More concentrated solutions of strong bases such as 10 per cent sodium hydroxide swell and soften, but do not readily remove the film.

The susceptibility of Carboset 514H resin to solvents is detailed below:

Solvents for Carboset 514H Films

| | | |
|--------------------|----------------|------------------------|
| Methanol | Dioxane | Methyl ethyl ketone |
| Ethanol | Cyclohexanol | Methyl isobutyl ketone |
| Isopropanol | Cyclohexanone | Methylene chloride |
| Methyl Cellosolve® | Methyl acetate | Pyridine |
| Acetone | Isophorone | Dimethyl formamide |
| Diacetone alcohol | Ethyl acetate | Tetrahydrofuran |

Partial Solvents for Carboset 514H Resin Films

The following solvents swell the dry films:

| | | |
|-------------------|----------------------|-------------------|
| Toluene | Propylene glycol | Turpentine |
| Benzene | n-Butanol | Dibutyl phthalate |
| Monochlorobenzene | Carbitol | Diisobutyl ketone |
| Glycerin | Carbon tetrachloride | Solvesso 100® |
| Ethylene glycol | Ethylene dichloride | |

Non-Solvents for Carboset 514H Resin Film

| | | |
|-------------------|---------------|------------|
| Mineral spirits | Apco thinner® | Kerosene |
| Diethylene glycol | Gasoline | Freon 113® |
| Hexane | Water | Heptane |
| Mineral acids | Solvesso 150® | |

Adhesion and Flexibility

The adhesion of 0.3-mil films of Carboset 514H resin was tested on brass, galvanized steel, aluminum, and cold-rolled steel panels by cellophane tape test on cross-hatched films. In no case was any of the Carboset 514H resin film removed. The same panels were subjected to bending over a 1/8-inch mandrel. None of the Carboset 514H resin films lost adhesion or cracked at the bend.

Cellophane tape adhesion tests on 0.3-mil Carboset 514H resin films on other substrates gave the following results:

| | |
|---|-----------|
| Saran-coated cellophane | Good |
| Untreated mylar | Poor |
| Glass | Good |
| Surface-treated polyethylene, polypropylene | Excellent |
| Untreated polyethylene | Poor |
| Flexible PVC | Good |

Applications

Corrosion Resistant Coatings with Carboset 514H

Carboset coatings of thin film weight based on the formulation below provide mild corrosion resistance under high humidity conditions for various metal substrates. Small metal parts, tools, and machinery can be given a protective coating of Carboset to keep them from rusting at least between the time of manufacture and the time of sale. The coating gives these items added sales appeal at very little cost.

Formulation for use on Copper and Brass

| | | |
|-------|-------|-----------------------------|
| 200.0 | parts | Carboset 514H resin |
| 800.0 | " | Demineralized water |
| 0.8 | " | tolyl triazole ¹ |

Procedure: Add the Demineralized water to the Carboset 514H, then add tolyl triazole and stir until dissolved.

This coating solution, being only 8% resin solids, yields a very thin coating (approximately 0.1 mil) containing 1 phr tolyl triazole for improved corrosion resistance and prevention of greening on copper and brass surfaces. Film thickness may be increased by increasing the resin solids while maintaining the 1 phr tolyl triazole ratio. This temporary Carboset coating can be easily removed with dilute alkali solution.

Water Based Permanent Coatings with Carboset 514H

Tough, flexible coatings resistant to solvents, alkalies, and acids can be formulated with Carboset 514H cured with either formaldehyde resins or epoxy resins. These cured Carboset resin coatings have extremely strong adhesion to difficult substrates such as Mylar, polyethylene and polypropylene.

The system accepts pigment readily and produces successful water-based printing inks, water-based industrial coatings and adhesives.

¹ tolyl triazole - Cembratec TT 100 available from Sherwin Williams Company

FORMULATION A

Melamine Formaldehyde Cure

36 parts Carboaset 514H resin
54 " Demineralized water
9 " Resimene RF5306¹

Procedure: Add the Carboaset 514H to the water, stir in well. Next add the Resimene and stir for 15 minutes. Coating solids may be adjusted by altering the amount of water added to the system.

Cure Conditions

60 minutes @ 200°F
10 " @ 250°F
2 " @ 300°F

¹Resimene RF5306 - melamine formaldehyde resin available from Monsanto Company.

FORMULATION B

Epoxy Cure

188 parts Carboaset 514H resin
62 " Demineralized water
25 " Epon 820¹

Procedure: Add the Carboaset 514H to the water, stir in well. Next add the Epon and stir for 15 minutes. Coating solids may be adjusted by altering the amount of water added to the system.

Cure Conditions

At room temperature, this cure requires approximately 6 days. Heat and suitable epoxy accelerators reduce the cure time considerably.

¹Epon 820 - Epoxy resin available from Shell Chemical Company.

Availability

Carboaset 514H resin is available in commercial quantities.

Service

If you have any questions concerning Carboaset 514H resin or desire samples, please contact:

B.F. Goodrich Chemical Company
Chemical Sales Department
3135 Euclid Avenue
Cleveland, Ohio 44115

Phone: Area 216/881-8200